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Characteristics of Calorific Value of Briquettes Made from Cymbopogon Citratus Waste as an Alternative Fuel

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ABSTRACT

Product diversification through Cymbopogon citratus briquettes as an alternative fuel for the development of renewable energy. The waste from the Cymbopogon citratus production process is a potential source of renewable energy that can be used as briquettes. This is an alternative to reduce dependence on fuel oil energy which is the main need for ordinary people. The purpose of developing Cymbopogon citratus waste briquettes with various variances and the use of tapioca adhesive, in obtaining the characteristics of the calorific value of briquettes. The method of making briquettes by using a press and optimizing the composition of the appropriate mixture as an effort to get the calorific value. From this research, the calorific value of Cymbopogon citratus briquettes is 8230.65 kJ/kg at a percentage mixture of 90:10 and its density is 394.90 kg/m^3. From the acquisition of these characteristic values, it can be recommended as an alternative fuel in an effort to develop renewable energy in the utilization of lemongrass waste.

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1. INTRODUCTION

The increase in oil prices, which until now continues to have an impact on the selling price in the community and burden the government with fuel subsidies. According to reports from various print and electronic media, it has reached around 211 trillion in 2012 where the world's energy needs will reach twice the current demand, especially oil. Of course, the price increase will affect the joints of people's lives, not only on support in the production and service sectors but also on the difficulty in getting it for household consumption needs. The unpredictable increase in fuel prices in the last decade has encouraged the development of bioenergy as an alternative energy source [1].

The acceleration of supply in various options and the adoption of alternative energy is one of the steps that must be taken in the future. Among other things, this can be achieved through the production of solid fuel types, such as lemongrass briquettes made from bagasse and durian skin. The success in processing and producing as well as its socialization will be able to reduce dependence on fuel oil or gas energy. How crucial it is, national energy security is actually still very fragile where Indonesia does not have SPR (Strategic Petroleum Reserves), so that this country will become the largest importer of fuel oil in the world [2].

Development of bioenergy as an alternative energy source, apart from the increasingly scarce fossil energy sources. National Energy Policy formulated by the government that it is necessary to increase the use of new energy sources and renewable energy sources [3]. As stated in the renewable energy development and energy conversion policy of the Ministry of Energy and Mineral Resources, it is stated that the potential for biomass energy in Indonesia is quite large which includes fuel from wood, agricultural & plantation/forest waste, organic components from industrial and household waste [4]. Wastes and residues from agriculture and industry can be used as alternative renewable sources to produce energy and raw materials such as chemicals, cellulose, carbon and silica [5].

One of the renewable energy that has great potential in Indonesia is biomass. Sugarcane is a potential alternative energy source because sugarcane produces biomass in the form of bagasse and dried sugarcane leaves and also durian plants which produce durian skin waste. Biomass can be burned in the form of powder, briquettes, or bars. Briqueting is an effective method for converting solid raw materials into a compacted form that is easier to use. Utilization of lemongrass waste as fuel for briquettes, which is processed with a combination of other potential sources of biomass energy, is one form of innovation in solid fuel products. Previously, research has been conducted on bagasse which produces a product in the form of sugarcane bagasse briquettes, which are potential candidates for alternative fuel [6]. The calorific value of combustion obtained in this study is in the range 15,000 – 20,000 kJ/kg and still has the opportunity to be increased. Through improvement of process technology and manipulation of test parameters/variables, as well as making a choice of mixtures of a number of other basic materials for biomass energy sources is an effort to improve the quality of the results. In addition, the results obtained in the form of recommendations on bagasse briquette fuel, in order to support the implementation of product diversification programs that still need to be followed up. The research on tibarau sugar cane briquette has been carried out which produces the calorific value characteristics of 11221,72 kJ/kg with a density of 565 kg/cm^3 in the composition of the percentage ratio of 80:20 [7]. Success does benefit in processing and producing areca fiber plant waste into raw material for briquettes so that it will reduce dependence on fuel oil energy [8]. The findings of this study are answers to these energy problems as well as support for government policies in the energy sector, particularly related to the development of biomass energy and renewable energy.

The purpose of this research is to increase and improve the calorific value characteristics of briquettes made from Cymbopogon citratus or lemongrass. It is hoped that briquettes made from Cymbopogon citratus can become a type of alternative solid fuel that is of high quality and meets the requirements to be commercialized in achieving the development of renewable energy. This is possible as a novelty development in finding biomass raw materials that have the potential to be used as fuel. Based on these discourses and conditions, this study will analyze the calorific value of lemongrass briquettes which can be developed as an alternative fuel.

2. METHODS

In this study, an experimental study was conducted on the characteristics of the briquette test sample. The orientation of the implementation of this research is focused on obtaining the characteristics of Cymbopogon citratus waste briquette fuel. The research raw materials were taken from lemongrass waste after the Cymbopogon citratus (lemongrass) oil extraction process was carried out (Figure 1). The adhesive used in the manufacture of Cymbopogon citratus briquettes is tapioca (Figure 2). The method of making Cymbopogon citratus briquettes is by percentage of the main raw material mixture to the adhesive, namely 90%: 10%, 80%: 20%, 70%: 30%, 60%: 40%. Then followed by testing activities in the laboratory for each test sample produced. In addition to these activities, work will be carried out before hand for the manufacture and development of auxiliary equipment needed for the briquette manufacturing process, as well as an inventory of raw material needs and the availability of fittings.

(a)

(b)

Figure 1**:** (a) Cymbopogon citratus waste and (b) Cymbopogon citratus particles

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Figure 2: Tapioca adhesive

In carrying out this research, the availability and procurement of laboratory test equipment is required. The prototype of the lemongrass briquette obtained was subjected to further testing and treatment as well as selection. Tests that are very urgent, especially those related to the heat energy of combustion or calorific value by using the "Bomb Calorimeter" apparatus (Figure 3).

Figure 3: Bomb calorimeter apparatus

In the analysis of each type and composition of the mixture as well as the treatment parameters will be recorded and tabulated in a table designed as needed. According to the ASTM D5865 standard, the calorific value is determined in the standard bomb calorimeter test [9]. The briquette samples were tested on a bomb calorimeter and get test data. Furthermore, the test data processing is carried out by calculating mathematically using existing equations. So that the average calorific value of lemongrass briquettes is obtained from the whole tests performed. The equation used to calculate the total calorific value resulting from the combustion of the substance or sample under test. Equation used to calculate the calorific value of fuel is:

$$N_f = \frac{H \, . \, \Delta T}{m_f} \qquad (kJ/kg) \tag{1}$$

$$\Delta T = T_c - T_i \tag{2}$$

3. RESULTS AND DISCUSSION

In this study, as many raw materials as possible were prepared for the manufacture and printing of Cymbopogon citratus briquettes. The need for research raw materials in the form of Cymbopogon citratus pulp is calculated by predicting the number of variations of the mixture with tapioca adhesive. According to the line of thought presented in the research methods section, along with the work according to the technical briquette making so that several physical prototypes are obtained as a result of the manufacturing product. Figure 4 shows a briquette product produced from Cymbopogon citratus (Lemongrass) waste. Based on the procedure in the test using the Bomb Calorimeter, calorific values for the resulting prototype is as shown in Figure 5. The values obtained for a number of physical quantities i.e density and percentage optimum is as shown in Figure 6. The calculation which is conducted based on a standard formula derived by entering data from the measurement results on the test equipment used.

Figure 4: Cymbopogon citratus (Lemongrass) briquettes

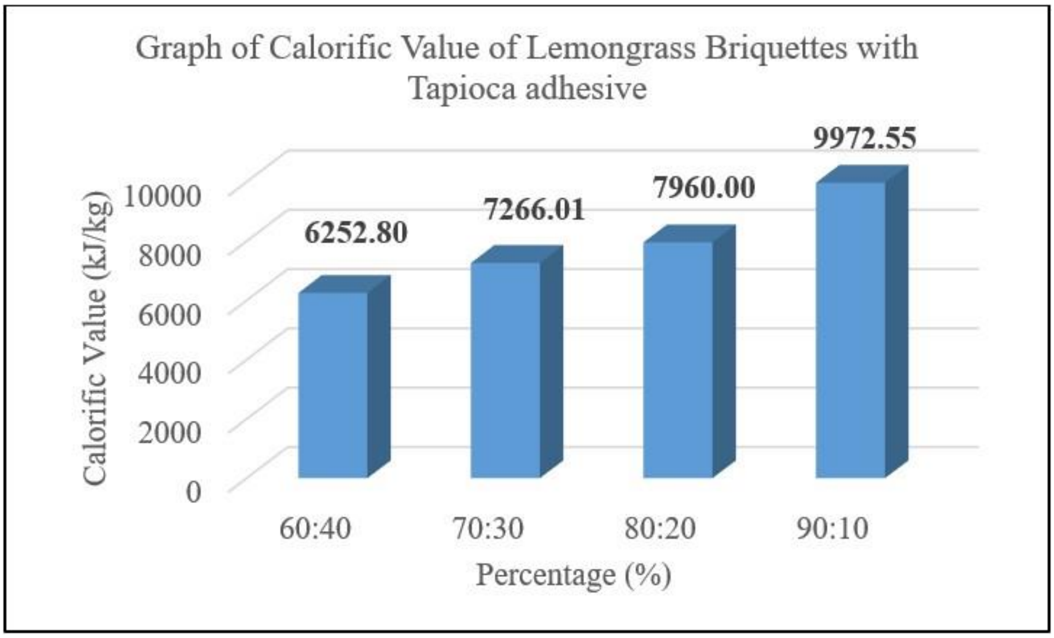

Figure 5: Graph of testing calorific value of lemongrass briquettes

From the results of the calorific value test of briquettes for all variations, from the analysis data it can be stated that the composition with the largest value is recommended to be produced more as the next test sample.

The lemongrass briquette which has the largest value is a mixture of 90: 10 percentage, which is 9972.55 kJ/kg with a density of 394.90 kg/m^3. Each lemongrass briquette has a different adhesive used. The impact of using different adhesives from the three produces different heating values. In accordance with its function, that the adhesive becomes the binder of the main ingredient particles, besides that the adhesive also makes an effort to have a good combustion rate on the briquettes so that they are easy to ignite.

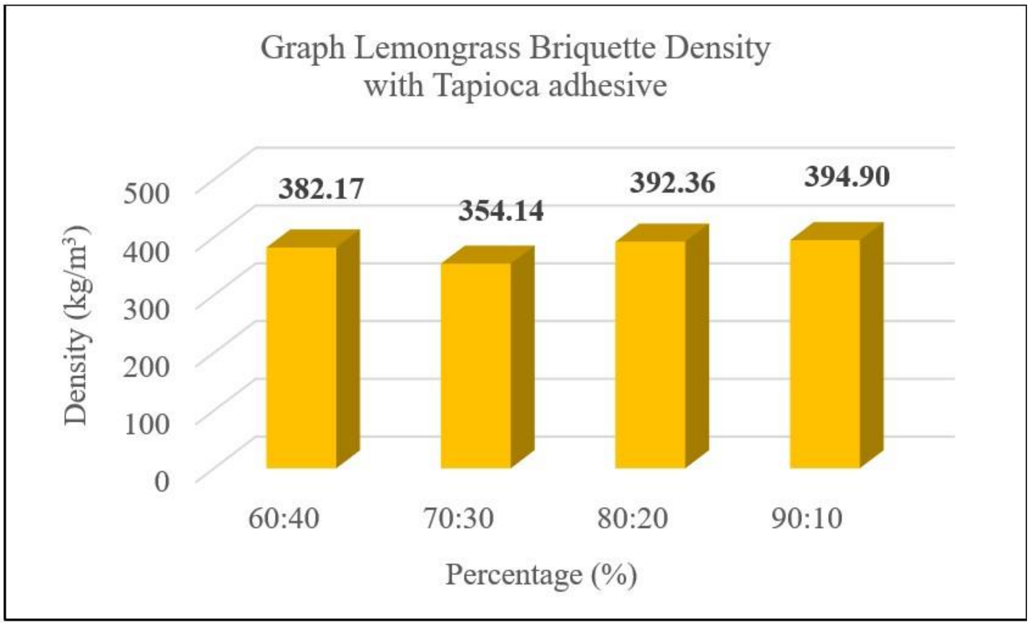

Figure 6: Lemongrass Briquette Density Graph

The use of adhesives shows potential in improving the quality of hybrid briquettes. However, the application of the amount of adhesive to the number of main ingredients is a concern in obtaining lemongrass briquettes with optimal quality. The physical properties of resin include being easily attached to room temperature, flammable, non-volatile if not decomposed [10], so it is widely stated that resin is one of the natural resins produced from diphterocarpaceae plants [11]. The physical and chemical properties of resin can be improved through purification using a combination of organic solvents [12]. In addition, many things can affect the calorific value of lemongrass briquettes as an alternative fuel including grain size, compression force (compact). Briquettes produced from raw materials for cymbopogon citratus waste can help the government to overcome the problem of waste which has been difficult to implement and reduce environmental pollution due to waste. Thus, briquettes made from cymbopogon citratus waste can be developed in people's lives as the forerunner of alternative fuels.

4. CONCLUSION

From this study, it can be concluded that this research has succeeded in utilizing waste sugarcane bagasse and durian skin as a candidate for solid fuel in the form of lemongrass briquettes as a renewable energy development using tapioca adhesive. The resulting lemongrass briquettes have the highest physical and chemical properties with a calorific value of 9972.55 kJ/kg in a mixture of 90:10 percentage and a density of 394.90 kg/m^3. The ratio of the binder/adhesive to the mass of the raw material (filler), grain size, compression force (compact), affects the density of briquettes, and at the same time this variable will determine the calorific value it produces. Briquettes made from cymbopogon citratus waste can be developed in people's lives as the forerunner of alternative fuels.

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NOMENCLATURE

N_f meaning of the calorific value of the test fuel (kJ/kg)
H meaning of calorimeter Water Constant (11.5664 kJ/^{o}C)
ΔT meaning of changes in temperature during combustion or temperature increase ^{o}C obtained from the bomb calorimeter test equipment.
T_c meaning of temperature after burning
T_i meaning of temperature before burning
m_f meaning of mass of fuel (kg)